

CLAIMS

1 1. A computer program product for compressing data
2 files representative of an image document having color
3 information and/or graphical information, said software
4 product disposed on a computer readable medium comprising
5 instructions for causing a computer to:

6 provide a first image file at a first resolution and a
7 second image file at a second resolution of said document
8 with said second resolution being lower than said first
9 resolution;

10 process the first image file to convert the first image
11 file into a text file representation of the document;

12 compress said text file representation of the document
13 to provide a first compressed file;

14 process said second file to extract information from
15 the image representation of the document corresponding to
16 color information and graphics information;

17 compress the second file using a second compression
18 technique to provide a second compressed file containing
19 information corresponding to the image; and

20 store said first and second compressed files and color
21 information to provide a composite compressed file
22 corresponding to the document.

1 2. The computer program product as recited in claim 1
2 wherein said instruction for causing the computer to provide
3 the image file comprises instructions for causing the
4 computer to scan the document at a first resolution to
5 provide said first image file at said first resolution and
6 scan the document at a second resolution to provide said

7 second image file at said second resolution.

1 3. The method as recited in conjunction with claim 2
2 wherein said instruction to process the second file to
3 extract information corresponding to color information
4 comprises instructions for causing the computer to:

5 determine foreground colors corresponding to colors
6 associated with text portions of the document.

1 4. The computer program product as recited in
2 conjunction with claim 3 further comprising instructions for
3 causing the computer to:

4 determine the foreground colors by causing the computer
5 to retrieve a plurality of samples of groups of pixels from
6 the low resolution image representation of the document and
7 from each one of said samples of pixels finding a pixel
8 corresponding to the minimum and maximum intensity of the
9 pixels in the sample; A

10 and for each one of said samples
11 calculate a threshold value representative of the
12 document by averaging the minimum and maximum intensities
13 for each of the blocks;

14 determine a color associated with each one of the
15 blocks and the width of intensity of each one of the blocks
16 and

17 provide a data structure having an entry for each one
18 of said blocks corresponding to a foreground color and a
19 background color.

1 5. The computer program product as recited in
2 conjunction with claim 1 further comprising instructions for
3 causing the computer to detect and remove data in said image
4 representation of the document which when viewed on a
5 display depicts a crease over a portion of the document.

1 6. The computer program product as recited in
2 conjunction with claim 5 comprises instructions for causing
3 the computer to:

4 form a first mask to apply to the text representation
5 of a document to mask out portions of said representation
6 corresponding to image portions of the document; and

7 provide a second mask to apply to the low resolution
8 image portion of the document to mask out portions of said
9 document corresponding to text portions of the document.

1 7. A computer system including a computer software
2 product for compressing data files representative of an
3 image document, said document including color information
4 and/or graphical information, said computer system
5 including:

6 a processor to execute said software instructions;
7 a memory storing said software program;
8 a display which displays representations of said
9 document;

10 said software product disposed on a computer readable
11 medium comprising instructions for causing a computer to:

12 provide a first image file at a first resolution
13 and a second image file at a second resolution of said

14 document with said second resolution being lower than said
15 first resolution;
16 process the first image file to convert the first
17 image file into a text file representation of the document;
18 compress said text file representation of the
19 document to provide a first compressed file;
20 process said second file to extract information
21 from the image representation of the document corresponding
22 to color information and graphics information;
23 compress the second file using a second
24 compression technique to provide a second compressed file
25 containing information corresponding to the image; and
26 store said first and second compressed files and
27 said color information to provide a composite compressed
28 file of the document.

662760-9006550
1 8. The computer system as recited in claim 7 wherein
2 said instruction for causing the computer to provide the
3 first file comprises instructions for causing the computer
4 to scan the document at a first resolution to provide said
5 first image file at said first resolution and scan the
6 document at a second resolution to provide said second image
7 file at said second resolution.

1 9. The computer system as recited in conjunction with
2 claim 8 wherein said instructions for causing the computer
3 to process the second file to extract information
4 corresponding to color information comprises instructions
5 for causing the computer to:

6 determine foreground color corresponding to colors

7 associated with text portions of the document.

1 10. The computer system as recited in conjunction with
2 claim 9 further comprising instructions for causing the
3 computer to

4 determine the foreground colors by causing the computer
5 to retrieve a plurality of sample of pixels from the low
6 resolution image representation of a document and from each
7 one of said samples of pixels finding a pixel corresponding
8 to the minimum and maximum intensity of the pixels in the
9 sample;

10 and for each one of said samples

11 calculate a threshold value representative of the
12 document by averaging the minimum and maximum intensities
13 for each of the blocks;

14 determine a color associated with each one of the
15 blocks and the width of intensity of each one of the blocks;
16 and

17 provide a color data structure having an entry for each
18 one of said blocks corresponding to a foreground color and a
19 background color.

1 11. The computer system as recited in conjunction with
2 claim 7 further comprising instructions for causing the
3 computer to:

4 detect and remove data in said image representation of
5 the document which when viewed on a display forms a crease
6 over a portion of the document.

1 12. The computer system as recited in conjunction with

claim 11 comprises instructions for causing the computer to:
form a first mask to apply to the text representation
of a document to mask out portions of said representation
corresponding to image portions of the document; and
provide a second mask to apply to the low resolution
image portion of the document to mask out portions of said
document corresponding to text portions of the document.

15. A computer program product operable to determine a
dominant background color associated with an image
representation of a document comprises instructions for
causing a computer to:

retrieve background color information associating a
background color with each one of a plurality of samples of
pixels representing the document;

filter said background colors to provide a target
number of colors to represent the background colors;

apply a median cut analysis to the background color
samples to filter said background samples into one of a
plurality of boxes corresponding to said target number of
colors;

sort said boxes by increasing volume;

sort a first portion of said boxes having the smallest
amount of volume by decreasing intensity; and

determine the dominant background color as a color to
represent the background of the document by the box having
the lowest intensity.

16. A computer program product for decompressing a
file containing image information and text information, said

3 program residing on a computer readable medium comprising
4 instructions for causing a computer to:

5 decompress the file containing image information and
6 text information into an image file and a text file;

7 allocate a target bit map to represent the decompressed
8 file;

9 insert the decompressed image information into the
10 target bit map at locations specified by information
11 contained in said file containing image information and text
12 information; and

13 insert text information into said target bit map in
14 accordance with positional information provided from the
15 decompressed text file.

1 17. The computer program product of claim 16 further
2 comprising instructions for causing a computer to display
3 the reconstructed representation of the decompressed file on
4 a computer monitor.

1 18. The computer program product of claim 16 further
2 comprising instructions for causing a computer to fill the
3 target output bit map with a color corresponding to a
4 dominant background color provided from color information in
5 the file.

1 19. The computer program product as recited in
2 conjunction with claim 18 further comprising instructions
3 for causing a computer to apply a color to the text
4 information in the target bit map in accordance with said
5 color information provided from said file.

6 20. A computer system including a computer software
7 product, said computer system including:

8 a processor to execute said software instructions;
9 a memory storing said software program;
10 a display which displays representations of said
11 document, for compressing data files representative of an
12 image document, said document including color information
13 and/or graphical information;

14 said system operable to determine a dominant background
15 color associated with an image representation of a document
16 containing color and text information comprises instructions
17 for causing the computer to:

18 retrieve background color information associating a
19 background color with each one of a plurality of samples of
20 pixels representing the document;

21 filter said background colors to provide a target
22 number of colors to represent the background colors;

23 apply a median cut analysis on the background color
24 samples to assign said background samples into one of a
25 plurality of three dimensional boxes in R-B-G color space,
26 said plurality corresponding to said target number of
27 colors; and

28 determine the dominant background color as a color to
29 represent the background of the document by the three
30 dimensional box having the lowest intensity.

1 21. The computer system of claim 20 wherein the
2 computer program product further includes instructions for
3 causing the computer to

4 sort said three dimensional boxes by increasing volume;

5 and

6 sort a first portion of said three dimensional boxes
7 having the smallest amount of volume by decreasing intensity
8 to determine the dominate background color.

1 ²⁰ 22. The computer of claim 21 wherein the computer
2 program product further includes instructions for causing
3 the computer to sort the three dimensional boxes in R-G-B
4 space by increasing distance (D) from the dominant
5 background color determined by:

6
$$D = \text{sqrt}((R1 - R2) * (R1 - R2) + (G1 - G2) * (G1 - G2)$$

7
$$+ (B1 - B2) * (B1 - B2)).$$

1 ²¹ 23. The computer of claim 21 wherein the computer
2 program product further includes instructions for causing
3 the computer to estimate a width of the dominate backgroud
4 color by using a distance to one of the boxes in the first
5 portion of boxs as the width estimate.

1 ²² 24. The computer of claim 21 wherein the computer
2 program product further includes instructions for causing
3 the computer to map colors to the dominate background color.

1 ²³ 25. A computer program product for a reading machine
2 to read words from a document allowed to a user and residing
3 on a computer readable medium comprising instructions for
4 causing a computer to:

5 decompress a file comprising image and text into an
6 image file and text file;

7 reconstruct the document from the decompressed image

8 file and text file;

9 apply color to the text in accordance with color
10 information provided from the file comprising image and text
11 and positional information provided from said text file;

12 display the reconstructed image representation of the
13 document on a computer monitor; and

14 manipulate the displayed reconstructed image
15 representation of the document by using positional
16 information in the text file.

24
1 26. The computer program product of claim 25 further
2 comprising instructions for causing the computer to scale
3 the positional information in the text file for manipulation
4 of the image in accordance with a resolution of the image
5 file and a resolution of the text file.

25
1 27. The computer program product as recited in
2 conjunction with claim 26 wherein said program further
3 comprises instructions for causing the computer to:
4 permit the user to select a document item from a
5 displayed reconstructed image representation of the
6 document; and

7 apply the converted text representation corresponding
8 to the document item to a speech synthesizer to cause the
9 computer to output a synthesized speech representation of
10 the document item.

26
1 28. The computer program product as recited in
2 conjunction with claim 27 further comprising computer
3 instructions for causing the computer to display image

4 representation of the document to be highlighted by applying
5 a highlighting indicia to the displayed reconstructed image
6 representation in accordance with scaled positional
7 information provided from the text file.

27
1 29. The computer program product of claim 28 further
2 comprising instructions for causing a computer to display
3 an image representation of a document item to be highlighted
4 with a color by applying a color to the displayed image
5 representation in accordance with positional information
6 provided from the converted text file.

23
1 30. A method of compressing an image representation of
2 a document having color portions and text portions comprises
3 the steps of:

4 scanning a document to provide a first file at a first
5 resolution and a second file at a second, lower resolution;

6 converting the first file into a text file;

7 applying an auto-rotate filter to the first file to
8 correct said file for errors;

9 converting said high resolution image file into an
10 optical character recognition file having text information
11 and positional information corresponding to the text
12 information on the image document;

13 masking portions of said optical character recognition
14 file corresponding to portions of said document representing
15 graphical information associated with the document; and

16 compressing the unmasked portions of said optical
17 character recognition file to provide a compressed text
18 file;

19 applying a rotate filter to the second file to correct
20 errors in said second file;

21 determining from said second file foreground colors
22 associated with each of the sections of said document and
23 background colors associated with each portion of said
24 document;

25 determining from said background colors a dominant
26 background color that best represents the background color
27 of the document;

28 masking portions of said document not corresponding to
29 the graphical portions of the document; and

30 compressing said unmasked portions to provide a second
31 file corresponding to graphical portions of the document and
32 storing said color information, and said first and second
33 files as a composite file.

29

34 31. A reading machine comprising:

35 a computer, said computer comprising:

36 a processor;

37 a computer monitor for displaying the image
38 representation of a document having text and graphical image
39 content;

40 a mass storage device, said storage device including
41 software comprising instructions for causing the computer
42 to:

43 decompress a file into an image file and text
44 file;

45 reconstruct the document from the
46 decompressed image file and text file and apply
47 color to the text in accordance with color

15 information and positional information provided
16 from said text file; and
17 display the reconstructed image
18 representation of the document on a computer
19 monitor and manipulate the displayed reconstructed
20 image representation of the document by using
21 positional information in the text file.

30

1 32. A reading machine system of claim 31 further
2 comprising instructions for causing the computer to scale
3 the positional information in the text file for manipulation
4 of the image in accordance with a resolution of the image
5 file and a resolution of the text file.

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1 33. A reading machine system as recited in conjunction
2 with claim 32 wherein said program further comprises
3 instructions for causing the computer to:

4 permit the user to select a document item from a
5 displayed reconstructed image representation of the
6 document; and

7 apply the converted text representation corresponding
8 to the document item to a speech synthesizer to cause the
9 computer to output a synthesized speech representation of
10 the document item.

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1 34. A reading machine system as recited in conjunction
2 with claim 33 further comprising instructions for causing
3 the computer to display image representation of the document
4 to be highlighted by applying a highlighting indicia to the
5 displayed reconstructed image representation in accordance

with scaled positional information provided from the text file.

33 34
35. The reading machine system of claim 34 further comprising instructions for causing a computer to display an image representation of a document item to be highlighted with a color by applying a color to the displayed image representation in accordance with positional information provided from the converted text file.

34 35
36. A reading system comprising:
a computer, said computer comprising:
a processor;
a computer monitor for displaying an image representation of a document having text and graphic or image content information;
a mass storage device, said storage device including a computer program product for decompressing a file containing image information and text information, said program residing on a computer readable medium comprising instructions for causing a computer to:
decompress a file into an image file and a text file;
allocate a target bit map to represent the decompressed file;
insert the decompressed image information into the target bit map at locations specified by information contained in said file; and
insert text information into said target bit

21 map in accordance with positional information
22 provided from the decompressed text file.

35 34
37. The reading system of claim 36 further comprising
instructions for causing a computer to display the
reconstructed representation of the decompressed file on a
computer monitor.

40 37
38. The reading system of claim 36 further comprising
instructions for causing a computer to fill the target
output bit map with a color corresponding to a dominant
background color provided from color information in the
file.

37 36
39. The reading system as recited in conjunction with
claim 38 further comprising instructions for causing a
computer to apply a color to the text information in the
target bit map in accordance with said color information
provided from said file.

Sub A1 33 40. A computer program product for detecting a crease
in an input color image of a document, said software product
disposed on a computer readable medium comprising
instructions for causing a computer to:

retrieved data corresponding to portions of the page
that divides the page into sections;
and for each one of the sections

retrieve a one-dimensional array of pixels with a
length equal to the width of the portion; and

662760-9006660

10 determine for each of the one-dimensional array of
11 pixels whether the array has an intensity minima, by
12 measuring a distance from the center of an assumed intensity
13 minima out to a dominant background color.

3946
Sub 17 41. The computer program product of claim 40 wherein
2 for any slices that contain no dominant background color
3 pixels in the appropriate direction such samples are
4 considered to be invalid and are discarded.

40 41
42. The computer program product of claim 41 wherein
2 for those samples that have a dominant background color at
3 the appropriate location, a center for the crease is
4 determined by averaging the centers of the best slices.

41 42
43. The computer program product of claim 42 wherein
2 the first average of the centers of all the valid slices are
3 sorted by increasing distance from the first average and the
4 average is recomputed using only the centers of the highest
5 $(NSLICES/2)+1$, where $(NSLICES)$ is the number of slices.

42 43
44. The computer program product of claim 43 wherein
7 the whole area is considered to be invalid if there are less
8 than $(NSLICES/2)+1$ valid slices.

43 44
Sub 17 45. The computer program product of claim 44 wherein a
2 composite width is assigned for the area crease as the
3 minimum area slice width, and a composite vector of
4 intensities for each slice is constructed from the center
5 point of the crease to the near dominant background color

point for the slice.

44 45
Sub 17 46. The computer program product of claim 45 wherein
an array corresponding to the composite vector of
intensities for each slice is filled in as follows:

for a "center" area;

define slice(I) to be the pixel in a slice that is I
number of pixels from the center in the direction of the
near-DBC point; and

fill in the array;

array[i] = average of intensities of the slice[i]
pixels for the valid slices; and

iterate over I from the center out to the near-DBC
point as:

array[i] = maximum of array[i] and array[i - 1]

for each side of the crease, producing two arrays.

45 46
Sub 17 47. The computer program product of claim 45 further
comprising the step of;

assigning a quality to each area of the page with the
quality being equal to the width of the crease found or an
invalid crease indicator if the area/crease fails to qualify
as a crease

if there are less than $(NSLICES/2)+1$ valid slices, or
the width is below a minimum crease width, or if the
majority of centerpoints used to construct the average
centerpoint are not within a constant horizontal distance or
one another, or if the vector of intensities appears concave.

46 47
Sub 17 48. The computer program product of claim 47 wherein

the crease with the highest quality is determined as the crease for the page.

47. A computer program product for removing a crease stored on a computer readable media, comprises instructions for causing a computer to:

set all pixels to the outside of the center portion of a left or right side of the image crease to a dominant background color.

48 49
SUB B5 50. The computer program product of claim 47 further comprising instructions for causing a computer to:

set all pixels within a fixed distance to the dominant background color unless the width of the crease is less than a predetermined value; and

bleach all other pixels within the width of the crease between the center point and the near dominant background color point.

49 50
SUB A2 51. The computer program of claim 48 wherein the instruction for causing the computer to bleach comprises instructions for causing the computer to:

define array[i] to be the intensity in the creases's intensity vector at a distance i pixels from the center;

define image[y][x] to be the pixel in the image x pixels horizontally and y pixels vertically from the upper-left corner;

define center to be the center of the crease and width to be its width;

define intensity(pixel) to be a function that returns

12 the intensity of a pixel;
13 for a left-side crease, iterate over y, for each row in
14 the image, iterate over I from a fixed distance over crease
15 width:
16 if ((intensity(image[y][center + I] + (intensity(DBC) -
17 array[i]))) > (0.90 * intensity(DBC)))
18 set image[y][center + I] to DBC and set the
19 corresponding pixels in the B/W image to white.

1 52. A computer program product for detecting and
2 removing a crease in an input color image of a document,
3 said product disposed on a computer readable medium
4 comprising instructions for causing a computer to:
5 retrieved data corresponding to portions of the page
6 that divides the page into sections; and for each section
7 retrieve a one-dimensional array of pixels with a
8 length equal to the width of the portion;
9 determine for each of the one-dimensional array of
10 pixels whether the array has an intensity minima, by
11 measuring a distance from the center of an assumed intensity
12 minima out to a dominant background color;
13 set all pixels to the outside of the center portion of
14 a left or right side of the image crease to a dominant
15 background color;
16 set all pixels within a fixed distance to the dominant
17 background color unless the width of the crease is less than
18 a predetermined value; and
19 bleach all other pixels within the width of the crease
20 between the center point and the near dominant background
21 color point.

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